

CLAIMS

5 1. A method of providing a silicon micro-needle, the micro-needle having a base adjoining a silicon substrate, a tip remote from said base, and a duct in at least a region of said tip, the method comprising:

- a. providing a duct in said silicon substrate; and subsequently
- b. selectively removing the substrate from around the duct to provide a micro-needle coincident with the duct.

10 2. A method according to claim 1 wherein the duct passes substantially between the tip and the base

15 3. A method according to claim 1 ~~or 2~~ wherein a mask is lithographically provided on a substrate of the first material prior to the formation of the duct.

20 4. A method according to claim 3 wherein the mask is used to provide the duct which is fabricated by any one of the following techniques: plasma enhanced etching, laser ablation, light assisted anodisation, ion beam milling, focused ion beam milling.

25 5. A method according to ~~any one of the preceding~~ claims wherein the micro-needle is bounded by planes of the first material which have a low etch rate.

6. A method according to claim 5 wherein an anisotropic etch is used to selectively remove the first material.

7. A method according to ~~any one of the preceding claims~~ wherein the first material is removed by any one of the following methods: focused ion beam milling, etching combined with a domed resist mask.

8. A method of providing a silicon micro-needle, the micro-needle having a base adjoining a silicon substrate, a tip remote from said base, and a duct in at least a region of said tip, the method comprising:

a. selectively removing the silicon substrate to provide a micro-needle; and subsequently

b. providing a duct coincident with the micro-needle.

9. A method according to claim 8 wherein the duct passes substantially between the tip and the base.

10. A method according to claim 8 ~~or 9~~ wherein the micro-needle is bounded by planes of the first material which have a low etch rate.

11. A method according to claim 10 wherein an anisotropic etch is used to selectively remove the first material.

12. A method according to claims ~~8 or 9~~ wherein said micro-needle is formed by any one of the following techniques: focused ion beam milling, etching combined with a domed resist mask.

13. A method according to any one of claims ~~8 to 12~~ wherein once the micro-needle has been formed a planar surface is provide covering the micro-needle.

14. A method according to claim 13 wherein the duct is provided by lithographic processes performed on the planar surface.

15. A method according to claim 14 wherein once the duct has been provided the planar surface is removed.

5 16. A method according to ~~any one of the preceding claims~~ wherein the method is arranged to provide a micro-needle whose outer walls are inclined to a plane that is perpendicular to the substrate to which the micro-needles are adjacent.

10 17. A method of providing a micro-needle on the surface of a first material, the micro-needle having a base adjoining the first material, a tip remote from said base, and a duct in at least a region of said tip, the method comprising:

- 15
- a. providing a duct in said first material,
 - b. lining said duct with a second material, and
 - c. removing said first material from around said second material leaving a micro-needle fabricated from said second material attached to said first material and upstanding therefrom.

20 18. A method according to claim 17 wherein the duct passes substantially between the tip and the base.

25 19. A method according to claim 17 ~~or 18~~ wherein the second material is any one of the following materials: SiO₂, a metal, ceramic, a polymer, a semi-conductor.

30 20. A method according to any one of claims 17 ~~to 19~~ wherein a portion of the second material covering the inside surface of the duct is removed before or whilst the first material is removed from around the second material.

aa 5b A 21. A method according to any one of claims 17 to 20 wherein the first material is removed by etching.

aa 5 22. A method according to any one of claims 17 to 21 wherein a mask is lithographically provided on a substrate of the first material prior to the formation of the duct.

10 23. A method according to claim 22 wherein the mask is subsequently used to control fabrication of the duct.

aa 15 24. A method according to any one of claims 17 to 23 wherein the duct is fabricated using any one of the following processes: plasma based etching, laser ablation, focused ion beam milling, light assisted anodisation of silicon.

aa 20 25. A method according to any one of claims 17 to 24 wherein the second material is provided by any one of the following processes: oxidation, deposition.

aa 26. A method according to any one of claims 17 to 25 wherein the micro-needle is shaped by removing a portion of the second material.

aa 25 27. A method according to any preceding claim in which once the micro-needle has been created the method further includes linking the duct to a reservoir.

30 28. A method according to claim 27 in which a portion of the first material is removed from a side opposite a side of the first material where the micro-needle has been fabricated.

ah ^{Sub} ~~A1~~ 29. A method according to claims 27 ~~or 28~~ in which the first material is attached to a second piece of material.

5 30. A method according to claim 29 in which the second piece of material has a channel which connects to the duct and links the duct to a reservoir.

ah 10 31. A method according to claim 29 ~~or claim 30~~ in which the first material has a channel which connects to the duct and links the duct to a reservoir.

ah 15 32. A method according to any one of claims 29 ~~to 31~~ in which the two pieces of material are fabricated from same material.

ah 33. A method according to ~~any preceding claim~~ in which the micro-projection is fabricated substantially normal to the surface of the first material.

ah 20 34. A method according to ~~any one of the preceding claims~~ wherein a surface region of the micro-needle is porosified after the needle has been fabricated.

25 35. A method according to claim 25 wherein the porosification is provided by one of the following techniques: electrochemical anodisation, or immersing the structure in a stain etching solution.

ah *ah* 36. A micro-needle fabricated according to the methods of ~~any one of~~ claims 1 ~~to 35~~.

may. ant. test
bars